52. On Freshwater Decapod Crustacea (Families Potamonidæ and Palæmonidæ) collected in Madagascar by the Hon. Paul A. Methuen. By W. T. Calman, D.Sc., F.Z.S.†

[Received October 8, 1913 : Read November 11, 1913.]

(Plates XCI. & XCII.‡ and Text-figure 161.)

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INTRODUCTION.

The collection described in this paper was obtained in Madagascar in 1911 by the Hon. Paul A. Methuen, to whom I am indebted for the opportunity of examining it. The specimens are the property of the Transvaal Museum, Pretoria, but, by permission of the Acting Director of that institution, a selection from among them, including the holotype of the new species, has been retained for the British Museum.

For the purpose of comparison with Mr. Methuen's material the specimens of Potamonidæ and Palæmonidæ from Madagascar already in the British Museum collection have been re-examined and the results have been incorporated in the paper.

The following is a list of the localities whence Mr. Methuen's specimens were obtained. Those from the localities marked with an asterisk were collected for Mr. Methuen by M. Herschell-Chauvin of Tamatave :—

Eastern Region of Madagascar.

Manambato, streams running into Lake Rasoabé. July, 1911.

Ambilo, streams running into lagoon. July, 1911.

*Rapides de l'Ifotry, à deux jours de Tamatave. September, 1911.

*Ivondro. August, 1911.

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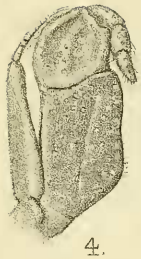
‡ For explanation of the Plates see p. 932.



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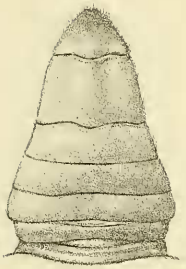

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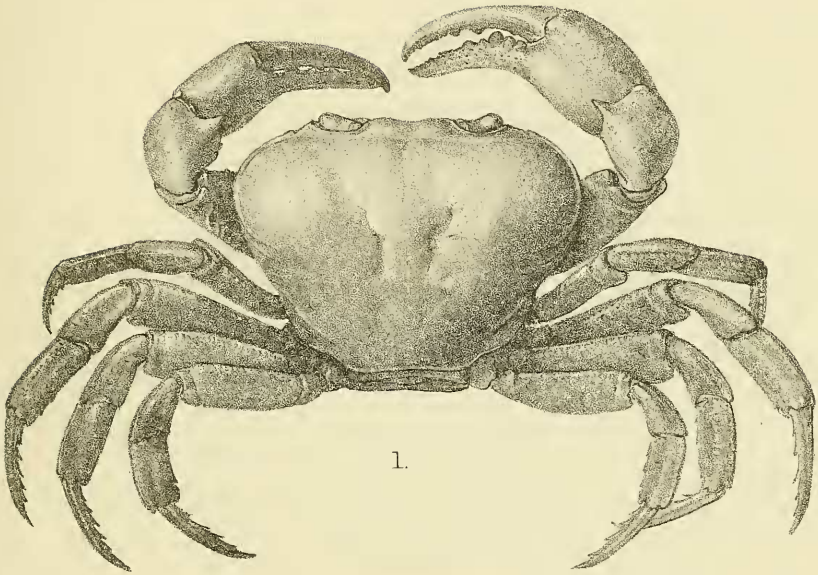

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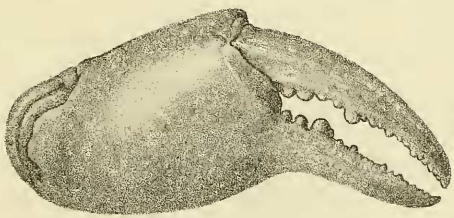

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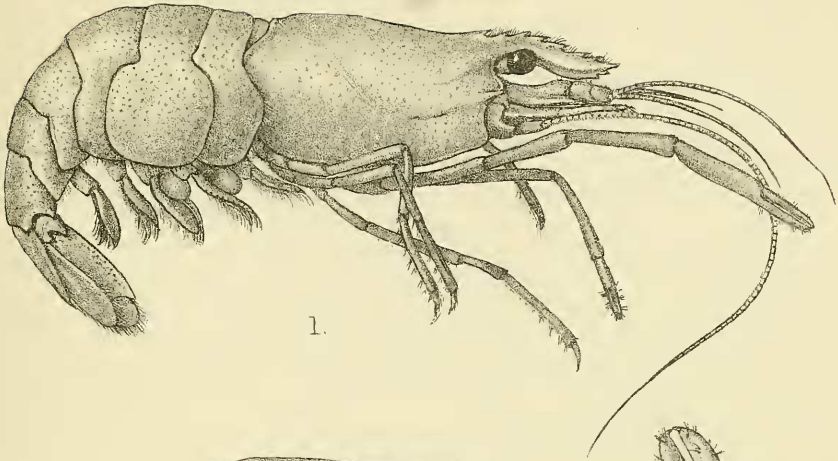
POTAMON METHUENI.



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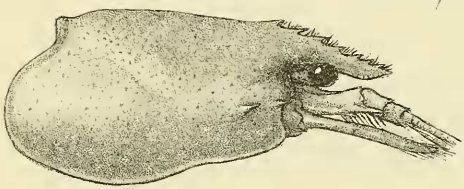

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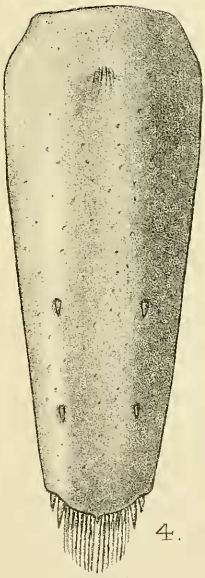

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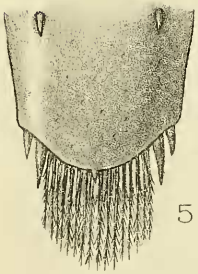

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G.M.Woodward del. et lith.

Huth imp.

PALÆMON HILDEBRANDTI.

Mountains leading to the Mangoro Terrace.

Ambatonharanana, near Ampasimpotsy. July, 1911.

Mangoro Terrace.

Imerimandrosa, northern end of Lake Alaotra, altitude 800–900 metres. July 1911.

Mountains leading directly to the Plateau.

Ambohidratrimo. June, 1911.

South-western Region.

Andranolaho and Tongoroby, Onilahy River, Dist. of Betsioky. October, 1911.

Part I.—Family Potamonidæ (River-Crabs).

1. *Description of the Material.*

The River-Crabs of Mr. Methuen's collection are referred to the following species:—

Potamon (*Potamon*) *madagascariense* A. Milne-Edwards.
„ „ *goudoti* H. Milne-Edwards.
„ „ *methueni*, sp. n.
Hydrothelphusa agilis A. Milne-Edwards.

As will be explained below, the specimens included under the first of these names differ considerably among themselves and represent at least three distinct forms which may possibly deserve to rank as varieties or even as species.

In the specific descriptions which follow, regard has been given chiefly to the characters of the carapace, to the exclusion of those of the appendages, since the latter seem to afford no useful points for separating the species here dealt with. Attention may perhaps be called to the difficulty of deciding whether any single specimen is to be regarded as adult. In the case of females the broadening of the abdomen seems to afford a fairly definite indication, and it is usually easy to sort the specimens into "adults" and "immature." In the males, however, the genital appendages of the first and second abdominal somites are often found apparently well developed in very small individuals, which differ considerably in the outline of the carapace from larger males.

In the lists of specimens the numbers preceded by the letters "B.M." refer to the British Museum Register of Crustacea. The measurements given in the tables are expressed in millimetres and were taken by means of a scale graduated to ·5 mm. No very high degree of accuracy can be claimed for them, but I believe that they are fairly comparable among themselves; it is not in all cases certain that they can be directly compared with

measurements given by other writers, owing to the frequent lack of precise indication of the points between which measurements have been taken. In those given here "length" is measured from the hinder edge of the carapace to the front in the median line, *i. e.*, to the bottom of the notch between the frontal lobes; "breadth" is the greatest breadth of the carapace wherever it may be; "exorbital width" is the distance between the tips of the exorbital teeth, and is therefore least accurate where these points are blunt and indefinite; "frontal width" is the most difficult of all to find fixed points for, owing to the obliquity of the sides of the front; the measurements here given have been taken between the innermost points of the orbits, *i. e.*, just above the antennal flagella, when the carapace is viewed from in front.

Complete references to the earlier literature relating to the species dealt with will be found in Miss Rathbun's monograph, to which I am glad to acknowledge my great indebtedness.

Potamon (Potamon) madagascariense A. Milne-Edwards.

Potamon (*Potamon*) *madagascariensis* A. M.-E., Rathbun, Nouv. Arch. Mus. Paris, (4) vi. 1904, p. 264, pl. ix. fig. 7.

I have ventured to group under this name a number of specimens which differ considerably among themselves, and of which some at least would probably be regarded by other students as representing distinct species. I have so grouped them, partly as a confession of failure, for I feel no great confidence that they really belong to a single species, although I have found no satisfactory characters by which to distinguish them, and partly in order to emphasize the fact that the various forms can be arranged, in a way that seems to me significant, around the typical form of the species. They radiate outwards from this typical form towards the other species of Potamonidæ recorded from Madagascar, and while in some cases there remains enough of a gap to justify the retention of the names given to these other species, the relations are clear enough to suggest for the Madagascar River-Crabs an autochthonous origin from some form resembling the typical *P. madagascariense*. Miss Rathbun, in her monograph, attributes a certain range of variation to this species, and notes that one of the forms shows a transition towards *P. humbloti*. If the view here put forward be correct, the range of variation must be considerably extended, and *P. humbloti*, *P. grandidieri*, and *P. bombetokense* must be included as varietal forms.

The specimens examined appear to fall naturally into five series as shown on the accompanying table of measurements. To avoid prejudging the question of their systematic rank, I designate these series by letters.

Measurements of *Potamon madagascariense*.

Locality, &c.	Sex.	Length.	Breadth.	Exorbital width.	Frontal width.	Breadth ratio.
SERIES A.						
Madagascar, B.M. 81.9	♀	50	66	45	20	1·32
„ B.M. 85.18	♀	30·25	39	28	12	1·28
„ „	♂	15·5	21·25	15·75	7	1·37
„ „	♂	11	14·5	11·75	5·25	1·31
„ „	♀	10	12·5	10	4·75	1·25
„ B.M. 79.20	♂	16·75	22	15·5	7·25	1·31
„ „	♀	13·5	17·25	13	6	1·27
„ „	♀	13	16·75	12	5·5	1·28
„ „	♂	12·75	16	12·5	5·5	1·25
Betsileo, B.M. 82.6	♂	25·25	33·5	23	10·5	1·32
„ „	♀	21	27·5	19·5	9	1·3
„ „	♀	20·25	26	18·25	8·5	1·28
„ B.M. 80.27	♀	28·5	36	24·5	11	1·26
„ „	♀	20·5	26	19	8·5	1·26
„ „	♂	19·75	25·75	18·25	8·5	1·3
SERIES B.						
Ifotry, Methuen, No. 90	♀	37·5	46·5	33·5	14·75	1·24
„ „ 91	♀	32·5	38·5	29	13	1·18
„ „ 92	♂	22·25	26·5	21	9·25	1·19
„ „ 93	♂	19·5	23·25	18·25	8	1·19
SERIES C.						
Ambatonharanana, Methuen, No. 25	♂	16·5	21·5	15	7	1·3
„ „ 19	♀	16·25	21	15·25	7·25	1·29
„ „ 27	♂	16	22	15·25	7·25	1·37
„ „ 23	♀	15·75	20·5	15	7	1·3
„ „ 21	♂	15·5	20·5	15·25	7	1·32
„ „ 24	♀	14·5	19	14·25	6·5	1·31
„ „ 20	♂	14·5	19	14	6·5	1·31
„ „ 22	♂	13·75	17·5	13·5	6	1·27
„ „ 16	♂	13·25	17	12·75	6	1·28
„ „ 26	♂	11	13·5	11	4·75	1·22
„ „ 15	♂	10·25	13	10·25	4·75	1·26
SERIES D.						
Madagascar, B.M. 88.5	♂	34	45·5	29·5	14	1·33
„ „	♀	35	45·5	29·5	14	1·3
SERIES E.						
Imerimandrosa, Methuen, No. 35	♂	47	57·5	41	17·25	1·22
„ „ 33	♂	46·5	58·75	39·5	17	1·26
„ „ 38	♂	45·5	56	38	16·5	1·23
„ „ 37	♂	38·5	47·5	33·5	14·75	1·13

SERIES A.—These specimens are all, without much doubt, referable to the typical form of *P. madagascariense* as described and figured by A. Milne-Edwards and by Miss Rathbun. The characters in which they differ among themselves are relatively unimportant, with two exceptions, viz. :—(1) the distance between the epigastric and the postorbital crests, which, in the largest

specimen (81.9), is a trifle less than half the distance between the former crest and the frontal margin, is about 2/5ths of that distance in the largest specimen from 85.18, 1/3rd in the largest from 82.6, and only about 1/4th in an adult female from 80.27, while in the smallest specimen from 85.18 the two crests are all but continuous; (2) the roughness of the surface of the carapace, which, in most of the specimens, is in accordance with the published descriptions and figures, becomes notably reduced in the specimens from Betsileo registered under the numbers 82.6 and 80.27; in these, the whole carapace is much smoother, with only a few oblique granules or raised lines near the antero-lateral margins and on the posterior branchial regions, and one or two obsolescent granules on the front; it is to be noted that the granulation or serration of the antero-lateral margins themselves is not correlated with the general roughness or smoothness of the surface, being stronger in the Betsileo specimens than in the much rougher specimens from 85.18.

In the smaller specimens of this series, especially in the two smallest from 85.18, the external orbital notch becomes very shallow or is altogether obliterated, and the outline of the carapace is more quadrilateral than in larger specimens.

Series B.—The four specimens of this series differ from those included in Series A in the relative flatness and narrowness of the carapace, which has the antero-lateral borders less arched, so that the lateral projection of the carapace beyond the exorbital tooth is only about 2/3rds of the greatest diameter of the orbit instead of at least 5/6ths as in the larger specimens of Series A. These differences, however, are rather less strongly marked in the larger than in the smaller specimens of this series. The frontal lobes are very prominent in one specimen, and in all there is a tendency for the margin of the front to be less deflexed than in Series A. The exorbital and epibranchial teeth are very prominent, and, although the carapace as a whole is much less rough than in the largest specimens of the first series, the epigastric and postorbital crests are sharply defined and the oblique lines on the lateral regions are numerous, sharply cut, and granulated. The marginal granules on the under surface of the merus of the chelipeds are very prominent and spiniform. It is worth noting that even in the larger of the two males the genital appendages are very short, less than half the length of the abdomen, and apparently immature.

This form or variety seems to me to lead in the direction of *Hydrothelphusa*.

Series C.—The largest female in this series is only 16·25 mm. in length, but is apparently adult; the largest male is a trifle larger. The carapace in all is rather convex, especially antero-posteriorly, and the front is bent downwards. The carapace, on the whole, is rather wide, the ratio of breadth to length being, in one specimen, as high as 1·37. The surface is rather smooth,

although not more so than in some specimens of Series A. The epigastric and postorbital crests are somewhat indefinite; in some specimens they are nearly in line, but in others they are separated by a distance estimated at 2/5ths of that between the epigastric and the frontal margin. The exorbital tooth is not prominent and the epibranchial is small.

The specimens of this series approach the *P. humbloti* and *P. grandidieri* of Miss Rathbun's monograph, especially perhaps the latter, although they do not agree exactly with the description of either. They differ so much among themselves in all the characters that might be used to distinguish them from the specimens of Series A, that I cannot regard them as specifically distinct; from Series B they are more easily defined.

Series D.—In the two specimens of this series the carapace is very smooth, the rugosities on the anterior part of the branchial region being hardly perceptible. The general antero-posterior convexity of the carapace is well marked, the various regions are also convex, and the grooves between them correspondingly distinct. The most characteristic feature is the inflation of the anterior branchial regions, which, in both, but especially in the female, is much more marked than in any of the specimens mentioned above. The antero-lateral marginal line is not prominent and its granulations are nearly obsolete. In the female the distance between epigastric and postorbital crests is nearly half that between the former and the front, while in the male the proportion is not more than two-fifths.

These specimens, which I cannot believe to be specifically distinct from the smoother specimens of Series A, approach *P. goudoti* in general aspect, and are separated from it chiefly by the character of the epigastric crests, which do not project nearly so far forwards, are much less oblique, and far more clearly disjoined from the postorbital crests than they are in that species.

Series E.—This series consists of four large, dark-coloured, male specimens which differ considerably from all those discussed above. The carapace as a whole is moderately convex, with the regions somewhat inflated and the grooves between them well marked. The surface is fairly smooth, with oblique striæ on the anterior part and more distinct raised lines on the posterior part of the branchial region. The crests are well defined and sharp, the epigastric well in front of the postorbital. The epibranchial tooth is large and the exorbital moderately prominent.

According to Miss Rathbun's analytical key to the species of the subgenus *Potamon* these specimens would be referred to *P. bombetokense*, described by her from a single male specimen. From the detailed description and figure of that specimen, however, they differ in the rather narrower carapace, in having the margin between exorbital and epibranchial teeth straight or slightly convex instead of concave, and, apparently, in having the inter-regional grooves more strongly marked.

Potamon (Potamon) goudoti H. Milne-Edwards.

Potamon (*Potamon*) *goudoti* H. M.-E., Rathbun, Nouv. Arch. Mus. Paris, (4) vi. 1904, p. 305, pl. xiii. fig. 10.

Measurements of *Potamon goudoti*.

Locality, &c.	Sex.	Length.	Breadth.	Exorbital width.	Frontal width.	Breadth ratio.
Madagascar (no locality), Methuen, No 55.	♂	30·25	41	26·5	12·75	1·35
Betsileo, B.M. 82.6	♂	31·5	42·5	28	13·5	1·35
„ „	♂	29	39	25·5	11·5	1·34
Antananarivo, B.M. 82.13 ...	♂	29	39·5	26	12	1·36
„ „ ...	♂	28	38·5	25·25	11·5	1·37
„ „	♂	27·25	36·25	24·25	11	1·33
„ „ (dry)	♂	29·75	41	26·5	12·75	1·37
„ „ „	♀	29	39·25	25·75	12·5	1·35
„ „ „	♀	28·5	37·5	21·75	11·75	1·31

The nine specimens agree in general with the published descriptions and figures of this species, and present no noteworthy differences among themselves.

Potamon (Potamon) methueni, sp. n. (Plate XCI.)

Measurements of *Potamon methueni*.

Locality, &c.	Sex.	Length.	Breadth.	Exorbital width.	Frontal width.	Breadth ratio.
Imerimandrosa, Methuen, No. 34.	♂	33	46·25	26·75	12·5	1·4
„ „ 36.	♂	30·75	43·75	25	12	1·42
„ „ 39.	♂	28·25	39	24	11	1·38

Description.—Carapace: length about five-sevenths of its breadth, very convex, especially from before backwards, gastric region sometimes below level of inflated anterior branchial regions; surface finely punctate, smooth. Oblique portions of cervical groove shallow and obscure, if produced forwards they would cut the line of the postorbital crest rather within the outer angle of the orbit; H-shaped depression well marked; posterior part of mesogastric region wider than urogastric, the latter fairly well defined posteriorly. On the anterior branchial region is a faintly marked oblique ridge nearly parallel to the cervical groove.

Epigastric crests not very prominent, more or less rugose, hardly oblique, situated entirely behind a line joining epibranchial teeth; they are continued, without interruption, into the protogastric portions of postorbital crest, which are very low, rounded, and ill-defined, except in so far as they are limited by the transverse depression behind each orbit; in general direction the postorbital crest is transverse, and it is not traceable external to its intersection by the cervical groove. Groove between the epigastric lobes bifurcating widely behind, the limbs angularly bent so as to become parallel. Front strongly deflexed, but with anterior margin visible from above; divided into two low rounded lobes, most distinct from above, less so from in front; with a smooth raised marginal line. Upper margin of orbit with a prominent smooth border, inclined forwards, with only a faint trace of a lobe in the middle, towards the exorbital angle which is not at all prominent or dentiform. Lower margin of orbit nearly straight as seen from below, and smooth or obscurely crenulated; without any trace of a notch or sinus below the exorbital angle. Antero-lateral margin strongly arched, with a distinct marginal line, which is smooth or, in the smallest specimen, obscurely crenulate, and runs on to dorsal surface behind. Postero-lateral border concave, with more or less distinct lines. Pterygostomial region and, less conspicuously, subhepatic region beset with tubercles.

Merus of third maxillipeds slightly wider than long; ischial groove rather nearer the inner than the outer margin.

Chelipeds unequal. Lower surface of merus margined with tubercles, which may become indistinct; a small blunt tooth near distal end of inner edge; upper edge rugose with a low subterminal tubercle. Carpus smooth and punctate externally; with two teeth on inner side and a variable number of small granules. Surface of hand smooth and rather coarsely punctate; fingers long, slender, and strongly deflexed.

Sixth somite of male abdomen shorter than its distal width.

Holotype, male, 33 mm. in length, in British Museum. *Paratypes*, the two other males mentioned above, in Pretoria Museum.

Remarks.—This species resembles, on the one hand, *P. goudoti* and, on the other, the smooth form of *P. madagascariense* described under Series D above. From the former it differs chiefly in the wider carapace (the concavity of the postero-lateral borders has the effect of increasing the apparent difference in this respect); in having the epigastric crests nearly transverse, lying behind instead of in front of the line joining the epibranchial teeth, and quite continuous with the obsolescent postorbital crests; in having the gastric region less elevated and the transverse convexity of the carapace therefore less marked; and in having no notch below the external orbital angle. Compared with *P. madagascariense* the same differences hold good, even although in that species the epigastric crests are less oblique and less advanced than they are in *P. goudoti*.

Hydrothelphusa agilis A. Milne-Edwards.

Hydrothelphusa agilis A. M.-E., Rathbun, Nouv. Arch. Mus. Paris, (4) vii. 1905, p. 266, pl. xvii. (Potamonidæ, xv.) fig. 7.

Measurements of *Hydrothelphusa agilis*.

Locality, &c.	Sex.	Length.	Breadth.	Exorbital width.	Frontal width.	Breadth ratio.
Ambatonharanana, Methuen, No. 10	♀	32	36·5	27·5	12·5	1·14
„ „ 11	♂	28·5	32·5	25·5	11·5	1·14
„ „ 12	♂	29·5	33·5	25·5	12·25	1·13
„ „ 13	♀	30·5	34·5	26·5	12·5	1·13
„ „ 14	♂	31·75	36·25	27	12·5	1·14
Ambohidratrimo, Methuen, No. 28	♀	27	31·25	23·5	11	1·15
„ „ 29	♂	31·5	38	27	13·5	1·2
„ „ 30	♀	38·5	45·5	32·75	15·5	1·18
„ „ 31	♀	27·5	32·5	23·75	11·5	1·18
„ „ 32	♂	26	30·25	22·75	10·25	1·16

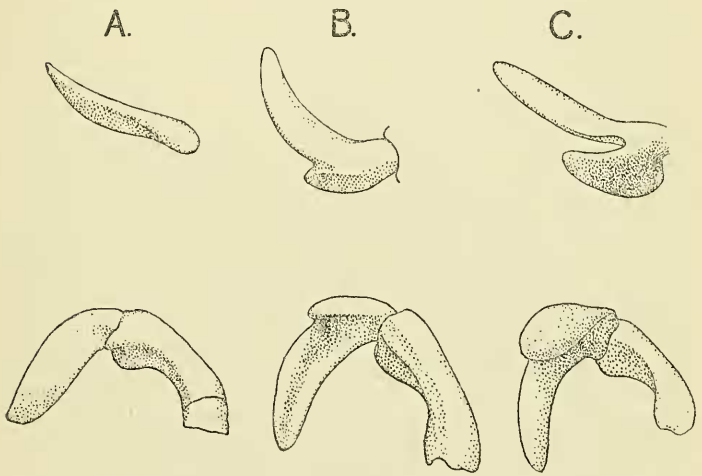
The arrangement of the spinules on the lower orbital margin is less regular and constant than is implied by Miss Rathbun's description. In other respects the specimens agree well with the published accounts of this species. All the female specimens, with the exception of No. 30, are clearly immature.

2. *Systematic Affinities of the Madagascar River-Crabs.*

In his monograph of the Indian River-Crabs (Cat. Crust. Indian Mus. pt. i. fasc. ii. Potamonidæ, 1910), and in a short but very important later paper on the classification of the family as a whole (Records Indian Mus. v. pt. iv. 1910, p. 253), Lt.-Col. Alcock has given an entirely new aspect to the system of the Potamonidæ. It is necessary, therefore, to enquire how the Madagascar species stand with reference to the new divisions of the family. Relying mainly, but not exclusively, on the character of the mandibular palp, Alcock has divided the River-Crabs of the Old World (apart from the aberrant Deckeniinæ) into the two subfamilies of Potamoninæ and Gecarcinucinæ. In the former (text-fig. 161, A) the terminal segment of the palp is simple, although it may be thickened and plumose at the base, while in the latter (text-fig. 161, C) it is "deeply cut into two lobes which embrace the incisor process of the mandible." Alcock refers the Madagascar genus *Hydrothelphusa* to the Potamoninæ, but he points out that "the thickening at the base of the terminal joint

of the mandibular palp is more than ordinary prominent." I find that this statement applies not only to *Hydrothelphusa*, but also, and in an even greater degree, to the other Madagascar species that I have examined. In *Hydrothelphusa* the proximal thickening forms a sharply marked ridge; in *Potamon madagascariense* (text-fig. 161, B), *P. goudoti*, and *P. methueni* this ridge overhangs a little as a free lobe. This evidently forms a transition to the bifid palp of the Gecarcinucinæ, although it is sufficiently far removed from the typical Gecarcinucine condition as seen in *Parathelphusa tridentata* (text-fig. 161, C), for example, to allow us to refer all the Madagascar species with confidence to the subfamily Potamoninæ, with which they also agree in

Text-fig. 161.



Mandibular palp (denuded of setæ) of three species of Potamonidæ. The lower figures represent the palp as seen from below, the upper figures the terminal segment as seen from in front. A. *Potamon fluviatile*. B. *P. madagascariense*. C. *Parathelphusa tridentata*.

the shape of the male abdomen. It is possible that a similar transitional form of the palp may yet be found in species of Potamoninæ from other parts of the world, but it is evident from Alcock's remarks that it does not occur in any of the Indian species; and, in the absence of evidence as to the species of the African and Malaysian Regions, it may be provisionally regarded as suggesting specially close affinity between the species found in Madagascar.

I do not think that much importance attaches to the fact that in all the Madagascar species the palp consists of only two

segments. Alcock found three segments distinct in all the Indian species of *Potamon*, but in his later paper he states that in the Potamoninæ the palp has either two or three segments. From the examination of a number of African species I suspect that it will not be possible to distinguish sharply between those species in which the suture-line between the first and second segments is well marked and those in which it is almost or quite obliterated.

As regards the generic affinities of the species here discussed, there is nothing to forbid the conclusion that they are closely interrelated. They have, indeed, been placed in two distinct genera, *Potamon* and *Hydrothelphusa*, and the species of the former might not unreasonably be placed in two subgenera, *Potamon* and *Geothelphusa*, but the groups indicated by these names are probably more convenient than natural. Both Alcock and Miss Rathbun comment on the close resemblance of *Hydrothelphusa* to *Potamon*, and Miss Rathbun specially mentions its affinity with *P. madagascariense*; this affinity becomes even more striking when comparison is made with some specimens of Mr. Methuen's collection which I have described above as representing a form of *P. madagascariense* (Series B). *Potamon goudoti* is considered by Miss Rathbun as forming a link between the subgenera *Potamon* and *Geothelphusa*, and the new species described above as *P. methueni* goes even further in the direction of the latter subgenus. There can, however, be little doubt that *Geothelphusa*, even as restricted by Alcock, has still very slender claims to be regarded as a natural or monophyletic group. A general softening of the asperities of the carapace, such as we frequently see within the limits of undoubted species, has only to be carried a little further to result in the obliteration of the postorbital and epigastric crests; and there is no difficulty in supposing that so short a step may have been taken independently by more than one evolving species. This independence is, in fact, implied by Alcock's transference of certain species of "*Geothelphusa*" to genera of his subfamily Gecarcinucinæ, and I think there is some slight evidence of the same thing among those that remain in the Potamoninæ. At all events there is no necessity to assume that *P. goudoti* and *P. methueni* are more closely allied to the species of "*Geothelphusa*" found in Africa and Asia than they are to *P. madagascariense*.

Potamon madagascariense itself is placed by Miss Rathbun in the group of which *P. edule* (*fluviatile*) is the type. While it certainly resembles the species of this group in the characters of the carapace, it differs a little, as already indicated, in the form of the mandibular palp, and also in some other small characters, such as, for instance, the much broader contact of the basal antennal segment with the front. What the exact value of these differences may be it is at present impossible to say.

3. *Geographical Relations of the Madagascar River-Crabs.*

In addition to the species mentioned above, three others have been recorded from Madagascar. The African *Potamon* (*Potamonautes*) *depressum* was recorded by Lenz and Richters, but its occurrence is doubted by Miss Rathbun. *Potamon* (*Potamon*) *pittarellii*, described by Nobili (Boll. Mus. Zool. Torino, xx. No. 507, 1905) since the publication of Miss Rathbun's monograph, appears to be allied to *P. madagascariense*, but is, no doubt, a distinct species. Finally, *Potamon* (*Parathelphusa*) *antongilense*, described by Miss Rathbun, is evidently a remarkable and isolated species, concerning which further information is much to be desired; as far as can be judged from the shape of the male abdomen, it is not a *Parathelphusa* in the sense in which that genus has been restricted by Alcock.

Leaving aside these three species, and considering only those that are represented in the collections now examined, it is evident that the Potamonid fauna of Madagascar bears no close relation to that of Peninsular India, which, as Alcock has shown, belongs entirely to the subfamily Gecarcinucinæ. This is important, since geologists seem to be agreed that the connection of Madagascar with India existed only at a time (not later than the early Oligocene) when Peninsular India was separated from the continent of Asia. Of the possible affinities with African species it is perhaps unsafe to speak until the rich Potamonid fauna of Africa shall have been examined as thoroughly as that of India has been by Alcock; but it is worth noting that no typical *Potamon* seems to be known from East Africa; and if, on the one hand, *P. madagascariense* is the most primitive of the Madagascar species, and, on the other, if it is really allied to the group of *P. fluviatile*, then it is hard to guess by what route it can have reached the island. Further than this it does not seem possible at present to go. As I have indicated above, our conceptions of the phylogenetic relationships of the species rest, as yet, on a very narrow basis of morphological fact; and, until that basis is broadened very considerably, the group of River-Crabs, as a whole, appears to me to be a hazardous subject for zoogeographical speculation.

Part II.—Family Palæmonidæ (River-Prawns).

The Palæmonidæ of Madagascar have already formed the subject of an important memoir by Coutière (Ann. Sci. Nat. Zool. (8) xii. 1900, pp. 249–342, 5 pls.), on which I have relied mainly for the determination of the four species in Mr. Methuen's collection. These are as follows:—

Palæmon lepidactylus Hilgendorf.
,, *dolichodactylus* Hilgendorf.
,, *ritsemæ* de Man.
,, *hildebrandti* Hilgendorf.

While all the adult males and a good many of the females in the collection have been referred to one or other of these species, there remain over a number of specimens which either lack the large chelipeds or are clearly immature. It is possible that these may include representatives of some other species, but I have not succeeded in identifying them, and it does not seem that any good purpose would be served by enumerating them here.

The most interesting species in the collection is that which I identify with *Bithynis hildebrandti* of Hilgendorf, which does not appear to have been re-examined since its description in 1897. The series of specimens collected by Mr. Methuen, together with those already in the Museum Collection, show, I think, that this species is not closely related to the Chilian species which is the genotype of *Bithynis*; that the single character which led to its being referred to the genus *Bithynis* is a matter of individual variation; and that, therefore, the species should be removed to the genus *Palæmon*.

Palæmon (Macrobrachium) lepidactylus Hilgendorf.

Palæmon lepidactylus Hilgendorf, Monatsber. Akad. Wiss. Berlin, 1878 (1879), p. 838, pl. iv. figs. 14–16.

Palæmon (*Macrobrachium*) *lepidactylus* Coutière, Ann. Sci. Nat. Zool. (8) xii. 1900, p. 272, pls. x., xi. figs. 1–13 *a*.

Localities. Ambatonharanana, 7 males (*Methuen*); Rapides de l'Ifotry, 1 male (*Methuen*); Betsileo, 3 males, B.M. 80.27.

In the characters of the rostrum and of the larger cheliped all the specimens fall within the range of variation determined for this species by Coutière. In no case, however, does the form of the smaller cheliped agree with that which he regards as typical. The fingers of this appendage are in all the specimens straight or nearly so, meeting completely or with only a slight gap, and having a scanty provision of bristles on their opposed edges. In these respects the specimens agree much better with Coutière's *P. hilgendorfi*, and suggest that that species should not be regarded as distinct from *P. lepidactylus*.

Palæmon (Parapalæmon) dolichodactylus Hilgendorf.

Palæmon dolichodactylus Hilgendorf, Monatsber. Akad. Wiss. Berlin, 1878 (1879), p. 840, pl. iv. fig. 18.

Palæmon dolichodactylus Coutière, Ann. Sci. Nat. Zool. (8) xii. 1900, p. 283, pl. xi. figs. 18, 19.

Localities. Andranolaho and Tongoroby, Onilahy River, 15 males, 3 females (*Methuen*).

The larger males in the collection agree very well with the accounts of this well-marked species given by Hilgendorf and by Coutière. With them are associated some smaller specimens in which the woolly covering of the larger chela is very slightly developed. The rostral formula is $\frac{13-15}{2-4}$, with 4–5 of the upper teeth postorbital.

Palæmon (Eupalæmon) ritsemæ de Man.

Palæmon (*Eupalæmon*) *ritsemæ* de Man, Zool. Jahrb., Abth. Syst. ix. 1897, p. 774: op. cit. x. 1898, pl. xxxvii. fig. 70.

Palæmon ritsemæ Coutière, Ann. Sci. Nat. Zool. (8) xii. 1900, p. 314, pl. xiii. figs. 32–33 *a*.

Localities. Manambato, streams running into Lake Rasoabé, 3 males, 8 females (*Methuen*); Ivondro, 6 males (*Methuen*); Ambilo, 2 males (*Methuen*); Tamatave, 1 male, B.M. 82.6.

The specimens collected by Mr. Methuen belong, without doubt, to the same species as a specimen in the Museum Collection from Tamatave, determined by Mr. Miers as *P. idæ* Heller. They differ conspicuously from typical specimens of that species, however, in the fact that the surface of the carapace and of the tail-fan is completely smooth or presents only very minute and inconspicuous traces of spinules, while the chelipeds of the second pair are very finely scabrous. Since Nobili has described a smooth or nearly smooth variety of *P. idæ* from New Guinea, and Coutière records a similar example from Madagascar, this character may not be of specific value. The chelipeds of the second pair are shorter, in relation to the body-length, than in Coutière's specimens of *P. idæ*, the longest being only about $1\frac{1}{5}$ of that length, and most of them being actually shorter. Although the carpus is, except in three instances, longer than the chela, the difference is very much less than is shown by Coutière's measurements in specimens of *P. idæ* of similar size, and the fingers are always much more than half the length of the palm. On the other hand, the rostral formula in nearly all cases falls within the somewhat narrow limits assigned to the variations of this character in *P. idæ*, and the armature of the fingers agrees precisely with Coutière's description.

In all the points mentioned in which these specimens differ from the descriptions of *P. idæ*, they approach Coutière's account of the form which he identifies with *P. ritsemæ* de Man. Our smaller specimens, however, which alone are directly comparable with Coutière's largest, have the second chelipeds more asymmetrical and apparently a good deal stouter, the chela itself, and especially the palm, being relatively a little shorter. The larger specimens have many of the proportions rather different, the greater relative length of the palm in most of them being noteworthy. Finally, in the specimens now examined, the posterior peræopods are, on the whole, stouter than in those previously described in this species, the ratio of length to breadth in the propodus of the fifth pair varying from 25 to 21, while de Man gives the ratio as from 35 to 25 and Coutière as 25.

On the whole, the balance of characters seems to be in favour of regarding our specimens as older individuals of the species to which Coutière's specimens belonged, which he has recorded under the name of *P. ritsemæ*; whether they really belong to de Man's species is, perhaps, a little more doubtful; and I am not at all

confident that they would be found to differ essentially from the smooth variety of *P. idæ*. It may be noted that, in having parts of the surface of the carapace slightly scabrous, some of our specimens agree with *P. sintangensis* de Man, which Coutière regards as a varietal form of *P. ritsemæ*.

The following table gives (in millimetres) the more important measurements of all the specimens that have one or both chelipeds of the second pair preserved. The "total length" of the body and also the "total length" of the chelipeds of the second pair are only approximate, on account of the impossibility of straightening the specimens without injury. In an ovigerous female the eggs measured ·5 × ·4 mm.

Measurements of *Palæmon ritsemæ*.

Locality, &c.	Sex.	Total length.	Rostral formula.	Chelipeds of second pair.					
				Total length.	Merus.	Carpus.	Chela.	Palm.	Fingers.
Ivondro, Methuen, No. 96 ...	♂	116	?	110	20	37·5	36	21	15
„ 95 ...	♂	105	$\frac{2+9}{4}$	123 93	20·5 18	43 29·5	38·5 27	24·5 17·5	14 9·5
„ 97 ...	♂	103	$\frac{2+9}{4}$	88	14	27·5	26	16	10
Manambato, Methuen, No. 42 ...	♂	98	$\frac{2+8}{4}$	74	12	22	23·5	13·5	10
Ivondro, Methuen, No. 99 ...	♂	95	$\frac{2+8}{4}$	93 73	16 14	31 24	29 26	17 14·5	12 11·5
Manambato, Methuen, No. 46 ...	♀	92	$\frac{3+8}{4}$	?	10	16·5	16·5	8·5	8
Tamatave, B.M. 82.6.	♂	90	$\frac{2+7}{3}$	90	18	35	33·5	20	13·5
Manambato, Methuen, No. 47 ...	♂	80	$\frac{2+8}{3}$	56·5	10	17·5	17	9·5	7·5
„ 45 ...	♀	75	?	?	9	15·5	15	8·5	6·5

PALÆMON HILDEBRANDTI Hilgendorf. (Plate XCII.)

Bithynis (?) *hildebrandti* Hilgendorf, Sitz.-Ber. Ges. Naturf. Freunde Berlin, 1893, p. 244; Coutière, Ann. Sci. Nat. Zool. (8) xii. 1900, pp. 250, 256, 259; Ortmann, Bronn's Thierreich, Crustacea, ii. 1901, p. 1292; Ortmann, Proc. Amer. Phil. Soc. Philadelphia, xli. 1902, p. 274.

The material which I have examined consists of eleven specimens, from three localities, in the British Museum (Nat. Hist.) Collection and nineteen specimens from one locality in Mr. Methuen's collection. The Museum specimens (Pl. XCII. fig. 1) agree with Hilgendorf's description of this species, except in one or two small details to be mentioned below. Mr. Methuen's specimens were at first regarded as representing a probably new species of *Palæmon*, since they possess a well-developed hepatic spine on the carapace (Pl. XCII. fig. 6). Closer examination showed, however, that they differed in no other respect from the Museum specimens, and their specific identity was finally proved by the discovery, among Mr. Methuen's specimens, of one which has no trace of a hepatic spine on one side of the carapace, while on the other side its place is indicated by a small and inconspicuous tubercle.

The following description applies to all the specimens examined.

The sides of the carapace and the abdominal somites are rather coarsely punctate. The rostrum is more or less straight, with the dorsal edge moderately arched, of varying length but always shorter than the antennal scale, and often shorter than the antennular peduncle; of the dorsal teeth, one is postorbital.

The tip of the telson (Pl. XCII. figs. 4 & 5) is rather broadly rounded, sometimes, but not always, with a minute median point; the inner lateral spines are much longer than the outer. Between the inner spines is a fringe of sixteen plumose hairs.

The third maxilliped does not reach the tip of the antennal scale. The chelipeds of the first pair extend beyond the scale by a little more than the chela.

The chelipeds of the second pair (Pl. XCII. fig. 2) are similar, smooth, with fine scattered setules, and may extend beyond the antennal scale by the length of the chela and carpus. The carpus is equal to the merus, widened distally; the chela slightly compressed (5 : 6), a little wider than distal end of carpus; palm longer than carpus and equal to fingers; fingers with a sharp cutting-edge for the greater part of their length, with two small teeth near the base of the dactylus, and one, with an indistinct second, on the immovable finger (Pl. XCII. fig 3).

Posterior legs moderately stout, propodus of last pair about twelve times as long as wide and about four times as long as the dactylus.

The females are ovigerous from a length of about 38 mm. upwards. The eggs measure approximately $2 \times 1{\cdot}4$ mm.

It will be observed, from the table of measurements given below, that the females are much more numerous than the males in the collections examined and also that they considerably exceed them in size; both conditions appear to be uncommon among the species of *Palæmon*, but they are found also in *P. moorei* of Lake Tanganyika.

Hilgendorf described the mandibular palp as consisting of only two segments. In all the specimens which I have dissected the usual three segments are distinct. Hilgendorf also attributes three teeth to the dactylus of the second chelipeds and states that

the carpus "ragt nur ein wenig unter die Antennenschuppe nach vorn," while in our specimen the dactylus bears only two teeth and the carpus may extend beyond the tip of the antennal scale. In all other respects, however, Hilgendorf's description applies so well to our specimens that their specific identity can hardly be in doubt.

The existence of an affinity between this species and the *Bithynis gaudichaudii* of Chile and Peru, asserted only in a hesitating manner by Hilgendorf, is fully accepted by Coutière, but denied by Ortmann, who considers that the resemblance does not extend beyond a single character (the lack of a hepatic spine) which may easily be supposed to have arisen by convergence. Ortmann's view is strongly supported by the variability of this character in the present series of specimens. I have examined the appendages of both species for other evidence of affinity between them, and have failed to find it. The branchial system and the mouth-parts of both are very similar to those of several species of *Palæmon* with which I have compared them. Only in one point do the mouth-parts of *B. hildebrandti* present anything unusual, and that is the reduced size of the epipodite of the first maxillipeds, but this constitutes no resemblance to *B. gaudichaudii*, in which the epipodite is quite as large as in the species of *Palæmon* examined. On the other hand, the differences in general aspect between the two species are considerable; *B. hildebrandti* has the chelipeds hardly differing in the two sexes, slender, symmetrical, smooth, with the carpus equal to the merus, and the fingers armed with only a few small teeth near the base; *B. gaudichaudii* is a very much larger species, with the chelipeds very stout, much more strongly developed in the male than in the female, very unequal on the two sides of the body, beset with spiny tubercles, with the carpus shorter than the merus, and the fingers of the larger chela toothed for half their length or more. If it be advisable to maintain the genus *Bithynis* (which seems to me doubtful) it must be for the South American species alone, and *B. hildebrandti* must be transferred to the genus *Palæmon*.

The variability of the hepatic spine in this species recalls the cases of "mutation" recently described by Bouvier in certain Atyidæ. It resembles these cases in its discontinuity, only one individual out of those examined being in any way intermediate between the two forms; and it further resembles some of them at least in the fact that it is geographically limited, for the specimens of the two forms come from different localities. Both of these points, however, require to be tested by further collecting. It differs from Bouvier's cases in that it concerns only a single character, and one which, were it not for its constancy in other Palæmonidæ, might be regarded as of trivial importance.

The large size of the eggs may be taken to indicate an abbreviation or suppression of the larval development, and this is likely to be associated, as it is in some other Palæmonidæ, with

an exclusively fresh-water habitat and a restricted area of distribution; it may be not without significance therefore, that, of the species of Palæmonidæ in the present collection, *P. hildebrandti* is the only one that does not occur outside the island of Madagascar.

Measurements of *Palæmon hildebrandti*.

Locality, &c.	Sex.	Total length.	Rostral formula.	Hepatic spine.	Chelipeds of second pair.				
					Merus.	Carpus.	Chela.	Palm.	Fingers.
Ambatonharanana, Methuen	♀	46	$\frac{1+6}{1}$	+	6·0	6·5	15·5	7·75	7·75
„	♀	45	$\frac{1+6}{0}$	+	.....	.....	.....	.....	.....
„	♀	45	$\frac{1+5}{0}$	+	5·3	5·5	14·0	7·0	7·0
„	♀	45	$\frac{1+5}{2}$	+	5·5	5·2	14·0	7·5	6·5
„	♀	44	$\frac{1+5}{0}$	+	5·5	5·5	14·0	7·0	7·0
„	♀	43	$\frac{1+6}{1}$	+	.....	.....	.....	.....	.....
„	♀	42	$\frac{1+5}{2}$	+	5·5	5·5	14·0	7·5	6·5
„	♀	40	$\frac{1+6}{0}$	+	5·5	5·5	14·0	7·0	7·0
„	♀	40	$\frac{1+6}{2}$	+	4·8	5·0	9·3	5·0	4·3
„	♀	39	$\frac{1+6}{1}$	+	5·2	5·5	14·0	7·5	6·5
„	♀	38	$\frac{1+7}{2}$	+	4·7	4·6	11·0	6·0	5·0
„	♀	38	$\frac{1+5}{1}$	+	4·0	4·0	10·0	5·2	4·8
„	♀	36	$\frac{1+7}{2}$	+	4·2	4·5	10·4	5·2	5·2
„	♀	36	$\frac{1+6}{2}$	+	4·5	4·5	9·5	5·0	4·5
„	♂	35	$\frac{1+5}{1}$	+	.....	.....	.....	.....	.....
„	♂	32	$\frac{1+7}{1}$	+	3·7	3·9	8·6	4·5	4·1
„	♂	32	$\frac{1+5}{1}$	+	4·0	4·0	9·3	5·0	4·3
„	♂	32	$\frac{1+6}{1}$	0	4·2	4·3	9·1	4·8	4·3
„	♂	28	$\frac{0+6}{0}$	+	.....	.....	.....	.....	.....

Measurements of *Palæmon hildebrandti* (continued).

Locality, &c.	Sex.	Total length.	Rostral formula.	Hepatic spine.	Chelipeds of second pair.				
					Merus.	Carpus.	Chela.	Palm.	Fingers.
Betsileo, B.M. 82.6.	♀	50	$\frac{1+5}{3}$	0	6·0 6·0	6·0 6·0	13·0 14·5	7·0 8·0	6·0 6·5
,, ,, ...	♀	48	$\frac{1+6}{2}$	0	.....	.....	.....	.....	.....
,, ,, ...	♀	46	$\frac{1+7}{2}$	0	5·7 5·7	5·7 5·7	13·0 12·2	7·0 6·5	6·0 5·7
,, ,, ...	♀	46	$\frac{1+6}{2}$	0	6·0 6·0	6·0 5·5	12·2 12·0	6·7 6·5	5·5 5·5
,, ,, ...	♀	46	$\frac{1+7}{3}$	0	6·0	6·0	12·0	7·0	5·0
,, ,, ...	♂	43	$\frac{1+8}{3}$	0	6·0	6·0	13·5	7·5	6·0
,, ,, ...	♀	38	$\frac{1+7}{2}$	0	4·5 4·5	4·5 4·5	8·9 8·9	4·7 4·7	4·2 4·2
Madagascar, B.M. 79.20	♀	52	$\frac{1+7}{4}$	0	.....	.....	.....	.....	.....
,, ...	♀	?	$\frac{1+5}{2}$	0	6·0	6·0	14·0	8·0	6·0
East Imerina, B.M. 92.7.4.6–7 ...	♀	37	$\frac{1+6}{1}$	0	.....	.....	.....	.....	.....
,, ...	♀	37	$\frac{1+6}{2}$	0	.....	.....	.....	.....	.....

EXPLANATION OF THE PLATES.

PLATE XCI.

Potamon methueni, sp. n.

Fig. 1. Male. Holotype. Natural size.
2. ,, ,, Hand of larger cheliped. × 1½.
3. ,, ,, Abdomen. × 1½.
4. ,, ,, Third maxilliped. × 2¼.

PLATE XCII.

Palæmon hildebrandti.

Fig. 1. Typical form, ovigerous female. × 2¼.
2. ,, Cheliped. × 5.
3. ,, ,, base of fingers. × 10.
4. ,, Telson. × 10.
5. ,, Tip of telson. × 15.
6. Form with hepatic spine. Carapace. × 2¼.